THE CITY OF SANTA BARBARA GENERAL PLAN

NOISE ELEMENT

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GENERAL PLAN

August, 1979

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NOISE ELEMENT

TABLE OF CONTENTS

*Available through Santa Barbara City Planning Department

LIST OF TABLES - TECHNICAL REPORT

LIST OF MAPS

ABBREVIATIONS

ADT Average Daily Traffic for a 24-hour day
ANSI American National Standards Institute (formerly USASI)
dBA A-weighted deciber (decibels). Also written dB (A)
EPA Environmental Protection Agency
Hz Hertz or wave cycles per second
L_{eq} Equivalent A-weighted sound level over a given time interval
$L_{eq(8)}$ Equivalent A-weighted sound level over eight hours
$L_{eq(24)}$ Equivalent A-weighted sound level over twenty-four hours
L_{dn} Day-night average sound level - the 24 hour A-weighted equivalent sound level with a 10 decibel penalty applied to nighttime levels
L_d Daytime equivalent A-weighted sound level between the hours of 0700 and 2200
L_n Nighttime equivalent A-weighted sound level between the hours of 2200 and 0700
L_{max} Maximum A-weighted sound level for a given time interval or event
NIPTS Noise-Induced Permanent Threshold Shift
NITTS Noise-Induced Temporary Threshold Shift
OSHA Occupational Safety and Health Act
SENEL Single Event Noise Equivalent Level

POLICY REPORT

INTRODUCTION

Noise affects man and his environment in a number of important ways. Some sounds cannot be heard or are not noticed, yet the human body reacts involuntarily to them. Other sounds are intense and quick to rupture the eardrum. However, all sound is not destructive. The point should be emphasized that sound is vital to communication and necessary for the maintenance of life.

Legislative Authority

In making city and county governments in California responsible for a Noise Element in their General Plans, the Legislature has recognized the steady escalation of outdoor noise as a significant environmental hazard. Unlike other hazards faced by California residents, such as earthquakes or floods, noise is generated primarily by man's own activities. Considering noise in the planning process, then, is essential to controlling its impact on the community. Specific authority for this Element of the General Plan is contained in Government Code Section 65302(g), which was revised by Senate Bill 860 (Bielenson, 1975). The amendment became effective January 1, 1976, and requires the following:

A noise element which shall recognize guidelines adopted by the Office of Noise Control pursuant to Section 39850.1 of the Health and Safety Code, and which quantifies the community noise environment in terms of noise exposure contours for both near- and long-term levels of growth and traffic activity. Such noise exposure information shall become a guideline for use in development of the land use element to achieve noise compatible land use and also to provide baseline levels and noise source identification for local noise ordinance enforcement.

The sources of environmental noise considered in this analysis shall include, but are not limited to, the following:

1. *Highways and freeways.*
2. *Primary arterials and major local streets.*
3. *Passenger and freight on-line railroad operations and ground rapid transit systems.*
4. *Commercial and general aviation; heliport, helistop, and military airport operations, aircraft overflights, jet engine test stands, and all other ground facilities and maintenance functions related to airport operation.*
5. *Local industrial plants, including, but not limited to, railroad classification yards.*
6. *Other ground stationary noise sources identified by local agencies as contributory to the community noise environment.*

The noise exposure information shall be presented in terms of noise contours expressed in community noise equivalent level (CNEL) or day-night average level (L_{dn}). CNEL means the average equivalent A-weighted sound level during a 24-hour day, obtained after addition of five decibels to sound levels in the evening from 7 P.M. to 10 P.M. and after addition of ten decibels to sound levels in the night before 7 A.M. and after 10 P.M. L_{dn} means the average equivalent A-weighted sound level during a 24-hour day, obtained after addition of 10 decibels to sound levels in the night before 7 A.M. and after 10 P.M.

The contours shall be shown in minimum increments of 5 dB and shall continue down to 60 dB. For areas deemed noise sensitive, including, but not limited to, areas containing schools, hospitals, rest homes, long-term medical or mental care facilities, or any other land use areas deemed noise sensitive by the local jurisdiction, the noise exposure shall be determined by monitoring.

A part of the noise element shall also include the preparation of a community noise exposure inventory, current and projected, which identifies the number of persons exposed to various levels of noise throughout the community.

The noise element shall also recommend mitigating measures and possible solutions to existing and foreseeable noise problems.

The state, local, or private agency responsible for the construction, maintenance, or operation of those transportation, industrial or other commercial facilities specified in paragraph 2 of this subdivision shall provide to the local agency producing the general plan, specific data relating to current and projected levels of activity and a detailed methodology for the development of noise contours given this supplied data, or they shall provide noise contours as specified in the foregoing statements.

It shall be the responsibility of the local agency preparing the general plan to specify the manner in which the noise element will be integrated into the city or county's zoning plan and tied to the land use and circulation elements and to the local noise ordinance. The noise element, once adopted, shall also become the guideline for determining compliance with the State's Noise Insulation Standards, as contained in Section 1092 of Title 25 of the California Administrative Code.

Purpose and Approach

As a mandated part of the General Plan, the Noise Element is intended to serve as the local government's guide to public and private development matters related to outdoor noise.

The basic goal of the Element is to outline a comprehensive plan to achieve and maintain a noise environment that is compatible with a variety of human activities in different land uses. To achieve this goal, the Element provides a quantitative estimate of noise exposures, land use noise standards, and policies and implementation measures for controlling noise. This information is intended for use in conjunction with other adopted policies of the General Plan, particularly those of the Circulation, Land Use, and Housing Elements.

This Noise Element has been prepared in two sections for the City of Santa Barbara. The first section, the Policy Report, is concerned with the implications of the technical findings for noise control. The second section, the Technical Report, and the Appendices, contain the quantitative estimates of existing and forecasted noise levels in the City, and document the methods used in computing noise exposure. Together, these two sections constitute the Noise Element.

The Noise Element is one of the more technical Elements of the General Plan. However, the approach of this report is to present discussions of noise primarily in qualitative form and to rely on the use of figures in presenting certain mathematical concepts. Those wishing a more detailed technical explanation are referred to the works listed in the General References.

Relationship to Other General Plan Elements

The Noise Element is most closely related to the Circulation, Land Use, Housing and Conservation Elements. The principal noise sources evaluated in the Element are transportation noise sources, which are road, rail, and air traffic. Noise generated by these sources depends primarily on the number and type of vehicles in operation as planned for in the Circulation Element.

Inseparable from the circulation considerations in the General Plan are the locations and types of land uses throughout the City. The locations of circulation routes in relation to different land uses can be a major determining factor of noise exposure. It is important that consideration be given in the Land Use Element to separating the most sensitive land uses from the sources of high noise levels. Land use noise standards are recommended as a part of this Element to assist in these considerations.

The Housing Element is related to the Noise Element in that both the location and insulation requirements of housing are, in part, determined by noise exposures.

The Conservation Element identifies passive areas such as open space along creek beds, where low noise levels should be maintained.

NOISE EXPOSURE

General

The existing and forecasted noise levels in the City of Santa Barbara are presented in graphic form on the Noise Contours Maps and in tabular form in Appendix C of the Technical Report. These noise levels are expressed in A-weighted decibels in terms of Day-Night Noise Levels (abbreviated L_{dn}). Detailed explanations of L_{dn} noise levels and the methods used to compute them are presented in the Technical Report. The following brief discussion is intended to provide a basic understanding of the terms to facilitate use of the Noise Contours Maps and Appendix C. Appendix A of the Technical Report provides a glossary with additional discussion of some of the more technical language.

Common noise experienced by each of us daily may range from a whisper to a locomotive train passing by. The range of sound *energy* represented by these two events is so large that it cannot be represented mathematically without using numbers in the millions and billions. To avoid this inconvenience, sound levels have been compressed in a standard logarithmic scale called the decibel (dB) scale. The reference level for the scale, O dB, is not the absence of sound, but the weakest sound a person with very good hearing can detect in a quiet place. The most important feature of the decibel scale is its logarithmic nature. An increase from 0 to 10 dB represents a tenfold increase in sound energy, but an increase from 10 to 20 dB represents a hundredfold increase, and from 20 to 30 dB represents a thousandfold increase over 0 dB.

The average range of sounds that we are commonly exposed to generally falls in the 30 to 100 dB range. However, not all sound waves affect us equally. The human ear is more sensitive to high pitch sounds, such as a whistle, than it is to low pitch sounds, such as a drumbeat.

To account for this effect in noise measurements, it is necessary to use an electronic filter in sound level meters which acts as the equivalent of the human ear in filtering out some of the lower frequencies of sound. This filter is called the A-scale weighting network, and is abbreviated by the A in the notation dBA.

A-scale decibel measurements can be taken at any time in the community to record the sound levels of various noise sources. However, to develop an indicator of varying sound levels occurring over the 24-hour day, it is necessary to average the sound occurring at each moment throughout the day. The Day-Night Noise Level is the result of this procedure, and gives a general, single-number index of noise exposure over an average 24-hour day. In computing the L_{dn} levels, it is also necessary to apply weighting to noise that occurs at night to account for the greater sensitivity that people have to noise at night. L_{dn} noise levels can be developed for road traffic, as well as for rail and air traffic for which the measure has been used traditionally. As examples of typical L_{dn} noise level ranges, Figure 1 gives ranges of L_{dn} decibel exposures ranging from quiet rural areas to an area under the flight path of a major airport.

FIGURE 1

Existing Conditions

The existing noise environment in the City of Santa Barbara is composed of sounds from many sources. Under the scope of this Element, the noise sources evaluated were road, rail, and air traffic. Parks, schools and hospitals were also monitored as noise sensitive land uses to determine if potentially incompatible noise levels impinged on them. The following are summary conclusions regarding the existing noise environment in the City:

1. In general, the City of Santa Barbara may be considered a relatively quiet environment. Ten potential major noise conflict areas were identified from a list of 98 possible problem areas within the City. An additional 12 potential minor conflict areas were also identified, based on the estimated locations of noise contours. Monitoring conducted at locations of noise sensitive uses revealed three more potential minor conflict areas. Of the more than one hundred road segments evaluated for traffic noise, segments on four principal roadways were associated with L_{dn} noise levels of 70 dBA or higher. This is not to say that the City is without noise problems. Rather the major noise sources are few in number and of limited

impact.

2. The most significant source of noise in the City is road traffic, followed by rail and air traffic. Of the roads evaluated for noise exposure, the following were found to be associated with L_{dn} noise levels of 70 dBA or higher: U.S. 101, State Street, Cabrillo Boulevard, and Las Positas Road. Table 5 of the Technical Report lists roads with L_{dn} noise levels of 65 dBA or higher.

3. Rail traffic on the Southern Pacific line is infrequent, but creates intense noise events such that the total sound energy associated with the railroad is nearly equivalent to that of U.S. 101. Noise sensitive areas potentially impacted by railroad noise include Wilson School, Bohnett Park, Palm Park, A Child's Estate, Andree Clark Bird Refuge, Dwight Murphy Field and the Moreton Fig Tree.

4. The Municipal Airport is a source of local noise. Most of the land within the 60 dB CNEL contour is under the jurisdiction of the County of Santa Barbara. Noise complaints are received from various areas within the County, including the University of California, Hope Ranch, and University Village. Land uses in areas immediately adjacent to the Airport, within the City limits, are primarily non-residential.

5. Table 1 contains a partial list of those noise sensitive uses which were found to be exposed to potentially incompatible noise levels according to the land use standards recommended in this Policy Report. The incompatibility is termed potential because the land use was evaluated only at a general level. Site acoustic analysis is necessary to determine the nature and extent of a noise problem, should one be confirmed to exist. Sources of the noise impinging on the land use or facility are also listed. Appendix F contains a list of rest homes and approximate noise levels at each location.

TABLE 1

POTENTIAL NOISE CONFLICT AREAS

Heavily Impacted Areas[1]	Local Noise Source(s)
Oak Park Convalescent Hospital	Highway 101
Santa Barbara Convalescent Hospital	Highway 101
Wilson School	Highway 101
Bohnett Park	Highway 101 & Railroad
A Child's Estate	Highway 101 & Railroad
Andree Clark Bird Refuge	Highway 101 & Railroad
Dwight Murphy Field	Highway 101 & Railroad
Moreton Fig Tree	Highway 101 & Railroad
Municipal Tennis Courts	Highway 101
Palm Park	Cabrillo Blvd. & Railroad
Residential areas adjacent to major noise sources	Highway 101, State St., Las Positas, Cabrillo Blvd. & Railroad

Slightly Impacted Areas[1]	Local Noise Source(s)
Oak Park	Highway 101 & Railroad
Las Positas Park	Las Positas Road
Adams School	Las Positas Road
McKinley School	Cliff Drive
Monroe School	Cliff Drive
Santa Barbara City College	Cliff Drive
Santa Barbara Jr. High	Milpas Street
West Beach	Cabrillo & Railroad
East Beach	Cabrillo
Ambassador Park	Cabrillo
Vera Cruz Park	Haley Street
Municipal Golf Course	Highway 101
Residential areas adjacent to minor noise sources	See Table 5 of Technical Report for noise sources

Additional Potential Conflict Areas[2]	Local Noise Source(s)
Lincoln School	
Anacapa	
Santa Barbara High School	

Anapamu
Plaza del Mar

Castillo & Cabrillo
[1] Based on estimated contours for 1978.
[2] Based on noise monitoring.

Future Conditions

In planning for noise control, it is necessary to estimate what the future noise environment may be like. Accordingly, noise level forecasts for the year 1990 were included as part of the technical analysis. In general, the future noise environment will be controlled by three factors:

1. The expected increase in the number of noise sources (e.g., traffic volumes).
2. The application of noise control technology to various sources.
3. Noise mitigation measures applied to exterior walls and exterior areas to decrease interior noise levels and noise levels in recreation areas.

It is reasonable to assume that noise control technology will be applied to some noise sources, and that this will counterbalance the increase in traffic, resulting in the same noise levels as currently exist or in decreased noise levels. No major technological breakthrough is foreseen for other noise sources, however, such as light aircraft, and the expected increase in volumes of these sources will mean an increase in noise levels. Even with the application of technology, high noise levels are expected to persist in some areas of the City, particularly along Highway 101. There are limits to what can be accomplished by technology alone, and this makes land use control a necessary component of successful noise control strategies. Summary conclusions regarding the expected future noise environment are as follows (see Section D, Future Noise Projection of Methodology Chapter of the Technical Report, for further discussion):

1. Forecasts of road traffic noise assume that noise control technology will be applied (as required in the California Vehicle Code, Section 21760), and that this will counteract the expected increase in road traffic in most, but not all, cases. Thus, road traffic noise is projected to remain the same or decrease somewhat by 1990 on most roads.
2. Current noise levels generated by the Southern Pacific Railroad are assumed to persist for at least the intermediate future, based on the assumption that existing levels of railroad traffic remain constant. If railroad traffic increases, noise levels will correspondingly increase.
3. The improvement in aircraft noise exposure resulting from compliance with Federal Aviation Regulation 36 may be partially offset by increased airport activity. Therefore, no dramatic reductions in aircraft engine noise are anticipated in the near future unless there is a major technological breakthrough. In the absence of accepted projections of air traffic growth for the Santa Barbara Municipal Airport, the noise contours projected by Bolt, Beranek and Newman are considered as adequately describing the 1990 noise exposure.

Effects of Noise in the City of Santa Barbara

Health and welfare criteria have been published by the federal Environmental Protection Agency, and these criteria can be compared to the noise levels quantified in this Element to draw some general conclusions. The basic criteria are given in Table 2, and utilize the Sound Equivalent Level (L_{eq}) and Day-Night Noise Level (L_{dn}). The L_{eq} is the basis for the L_{dn} noise level, but does not include a weighting for nighttime noise. It should be noted also that an "adequate margin of safety" has been built into these criteria.

Near Highway 101, the Southern Pacific Railroad, and the Municipal Airport, these criteria indicate that a certain level of activity (e.g., sleep, speech) interference and stress can be expected. However, it is unlikely that any resident's hearing is threatened unless he is spending unusually long periods of time in close proximity to these major sources.

TABLE 2

SUMMARY OF NOISE LEVELS IDENTIFIED AS REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY

(Source: U.S. Environmental Protection Agency, 1974)

Effect	Level	Area
Hearing Loss	$L_{eq}(24) \geq 70$ dB	All areas
Outdoor activity interference and annoyance	$L_{dn} \geq 55$ dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq}(24) \geq 55$ dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \geq 45$ dB	Indoor residential areas.
	$L_{eq}(24) \geq 45$ dB	Other indoor areas with human activities such as schools, etc.

Explanation

$L_{eq}(24)$ - Equivalent A-weighted Sound Level over a 24-hour period.

L_{dn} - Day-Night average sound level - the 24-hour A-weighted Equivalent Sound Level, with a 10-decibel penalty applied to nighttime levels.

dB - decibels.

NOISE CONTROL

Noise Regulations

Heightened concern in recent years for "environmental quality" has led to greater attention by the legislative and administrative branches of government to the problem of excessive noise. This attention has resulted in the enactment of a number of laws and regulations regarding noise. To provide the legal and planning contexts within which the recommended goals and policies of the Element would be implemented, this section summarizes the current noise laws and outlines possible noise control strategies.

Unfortunately, there has been little coordination among the agencies responsible for noise control, and this has resulted in the use of different noise evaluation techniques and standards in noise regulations. This non-uniform approach makes comparison and use of standards and regulations a confusing matter for both the general public and those government officials responsible for compliance at the local level. Table 3 provides a summary list of existing noise regulations which pertain to the City of Santa Barbara. In addition to those laws shown in the table, both the National Environmental Protection Act (NEPA) and the California Environmental Quality Act (CEQA) require environmental analysis of certain developments including an analysis of potential noise problems at the project site.

The most significant of the laws listed in Table 3 is the Noise Control Act of 1972. This law essentially authorizes the EPA to coordinate noise regulation at the national level. It also authorizes the EPA to set noise emission limits for major noise sources including aircraft, motor vehicles, and trains. These emission standards can be expected to have an important effect on future noise levels in the City. In addition, health and welfare criteria for noise exposure limits have been published in compliance with the Act, and these criteria have been incorporated into the recommended land use compatibility standards. In publishing these criteria, the EPA has selected and recommended the Ldn measurement scale for use as a uniform noise evaluation scheme. If nationwide use of this measurement becomes a reality, much of the existing confusion regarding noise should diminish. This should enable the city to enact noise control regulations and measurements consistent with other cities and counties as well as with the State and Federal government.

Alternative Noise Control

Any action to control noise will work on either the source of the noise, its transmission path, the receiver of the noise, or any combination of these facets of sound. As noted in the preceding section, source controls are primarily the responsibility of the Federal government, and to a lesser degree, the State government. Control of the reception of noise, however, has its roots in local government's traditional authority over land use control.

The basic goal of this Element is to achieve and maintain a noise environment that is compatible with a variety of human activities. This clearly calls for cooperation among all levels of government. Source controls are the most effective means of reducing noise, but there are limits to what can be accomplished through technology alone. A need for land use controls, coupled with source controls, will probably be necessary for overall noise reduction in many cities for the foreseeable future.

The purpose of this section of the Noise Element is to outline some of the land use and other types of noise reduction alternatives that are available for implementation by the City. These various strategies form the basic planning framework for the recommended goals and policies of the next sections.

Generally, noise control strategies may be thought of as belonging to one of five approaches. These strategies are: 1) to encourage voluntary noise reduction measures by property owners and developers; 2) to mandate compatible land use through zoning and planning powers; 3) to require noise reduction based upon environmental performance standards; 4) to encourage and require noise attenuation through a housing rehabilitation program; and 5) to enact noise control through government ownership of the affected property.

The first approach would include providing information to builders and the general public regarding the importance of noise reduction and different construction and site development techniques for noise compatibility. Various means of achieving this objective would include review of proposals by an architectural review board, design services by government staff during the permit application process, and maintenance of an acoustical information library for developers and the public. Education of the public is an important aspect of this approach since public awareness of noise problems can affect the marketability of developments. Such an approach can be successful in solving noise problems provided there is a degree of cooperation between the local government and developers or if the development market is a buyer's market and there is a demand for noise compatibility.

If these conditions do not exist, it may be necessary to use the local government police powers of zoning and planning to ensure that the public is protected from excessive noise. These measures can be an important influence on future development, but may be of little help in resolving existing noise problems. The basic approach is the exclusion of noise sensitive land uses from areas of high noise levels, such as along the Southern Pacific Railroad and Highway 101. If development is permitted in noise-impacted areas, zoning performance and development standards can regulate the details of the development such as building height, buffer areas, and noise barrier construction. Special types of development, such as cluster housing and planned unit developments, can be regulated to prevent unnecessary noise problems from occurring. Building codes may be enforced under this approach as well to limit the transmission of sound into and out of buildings.

One concept being implemented in a number of cities in California and across the country is the adoption and enforcement of environmental performance standards or a noise ordinance which sets quantitative limits on the level of noise permitted in different zones in the City.

A zone can be established in areas heavily impacted by noise (i.e., along Highway 101 and the Southern Pacific Railroad) which designates these areas as "blighted" due to high noise levels. A housing rehabilitation program can be instituted in these zones to provide low interest loans for modifying housing units to comply with acceptable noise levels. These noise "blighted" areas may also qualify for redevelopment funds.

TABLE 3
EXISTING FEDERAL AND STATE NOISE REGULATIONS

	Responsible Agency	Regulation/Standard	Noise Source Regulated	Summa
Federal	Environmental Protection Agency	Public Law 92-574 (Noise Control Act of 1972)	All	Gives EP standards welfare c recomme
	Federal Aviation Administration	FAR Part 36	Aircraft	Sets emis condition
	Federal Highway Administration	PPM 90-2	Highways, outdoor noise environment	Sets land developn
	Department of Housing and Urban Development	Policy Circular 1390.2	Airports, outdoor noise environments	Sets noise requestin
	Department of Labor	Occupational Safety and Health Act of 1970	Outdoor/Indoor noise environments	Specifies
State of California	Department of Aeronautics (Caltrans)	California Administrative Code, Title 4, Sub-Chapter 6	Airports, aircraft	Specifies near airp
	Department of Motor Vehicles	California Vehicle Code Section 23130	Motor vehicles	Sets noise specified
	Department of Transportation (Caltrans)	Streets and Highways Code	Highways	Requires freeways
	Commission of Housing and Community Development	California Administrative Code, Title 25, Article 4	Outdoor/Indoor noise environments	Limits in levels in
	Council on Intergovernmental Relations	California Government Section 63502(g) Amended by Senate Bill 860 (Beilenson, 1975)	Outdoor noise environment	Requires County C
	Department of Health, Office of Noise Control	Noise Insulation Standards	Indoor noise environment	Sets State

City ownership of noise-impacted land, the most restrictive approach, makes the regulation of its use a simpler matter. Purchase or the use of the power of eminent domain which fully compensates the property owner should be used rather than the purchase of an easement regulating the land without transfer of ownership.

Which of these approaches is used depends in large measure on the severity of the noise problem. The Technical Report of this Element concludes that, on the basis of the Noise Contour Map, most of the City of Santa Barbara is not heavily impacted by high noise levels except in close proximity to certain major sources such as U.S. 101, the Municipal Airport, and the Southern Pacific Railroad tracks (other noise sources are listed in Table 5 of the Technical Report). It is unlikely, then, that the City needs to consider the most restrictive approach, and can rely on zoning and planning to prevent major noise problems from occurring near these sources.

Most of the above strategies deal primarily with reducing future noise problems rather than existing ones. Where a noise problem already exists, one or more of five general solutions are available: 1) the noise can be reduced at the source; 2) the noise can be blocked by an insulating barrier; 3) the source can be removed from people and other receivers; 4) the receiver can be removed from the source; or 5) the time exposure to the noise can be minimized. As is true with most environmental hazards, preventing or reducing the cost of the future hazard is easier and less expensive than resolving existing problems.

GOAL AND POLICY RECOMMENDATIONS

Organization of Recommendations

The previous sections of this report provide a summary of the technical analysis of noise in the City of Santa Barbara, and a synthesis of the legal and planning frameworks for noise control. In this section, general planning goals and policies are recommended for the City of Santa Barbara. These recommendations constitute the noise control plan for the City and are the heart of the Noise Element.

The recommendations comprise a general planning goal, general policies, and more specific policies termed implementation strategies. The general goal provides a statement of the basic purpose of the Noise Element so that consistent planning is possible. It is a necessary guideline which can be held up against future proposals to determine their effect on the noise environment. The general policies complement the planning goal and define specific directions for the City to take in controlling noise. The implementation strategies are suggested refinements of the general policies and will be carried out through the development of City ordinances and regulations. Methods for implementation of the goals and policies need not be limited to those listed in this section, as other effective strategies may become apparent in the future.

While it would be desirable to fully implement each of the implementation strategies it is recognized that there are competing demands for preservation, enhancement, development, and conservation of resources, and the City's economic resources are limited. Therefore, priorities for the implementation of these strategies shall be determined by the City Council after consideration of economic, social, and environmental concerns weighted according to balance and priority.

Goal

To ensure that the City of Santa Barbara is free from excessive noise and abusive sounds such that: a) sufficient information concerning the City noise environment is provided for land use planning; b) strategies are developed for abatement of excessive noise levels; and c) existing low noise levels are maintained and protected.

In defining this goal, primary emphasis should be placed on protecting the general public from noise levels which may be hazardous to hearing. Second in importance is the minimization of noise induced stress, annoyance, and activity interference.

Policies

1.0 Land use noise compatibility standards should be established for general planning and zoning purposes.

2.0 Provision should be made for the identification and evaluation of potential noise problem areas.

3.0 Existing and potential incompatible noise levels in problem areas should be reduced through land use planning, building and subdivision code enforcement, and other administrative means.

4.0 Existing and potential incompatible noise levels in problem areas should be reduced through operational or source controls where the City has responsibility for such controls.

5.0 A program should be developed for the education of the community in the nature and extent of noise problems in the City.

6.0 Noise control activities should be coordinated with those of other responsible jurisdictions.

7.0 Provision should be made for periodic review and revision of the Noise Element.

Implementation Strategies

1.0 Land use noise compatibility standards should be established for general planning and zoning purposes.

- 1.1 Adopt the noise compatibility standards provided in Figure 2 for use in identifying potential noise problem areas, and in reviewing environmental impact documents.
- 1.2 Incorporate noise performance standards to mitigate peak noise levels into zoning and other appropriate ordinances.
- 1.3 Enforce noise compatibility standards for the mixed uses in the Lower East Industrial Area.
- 1.4 Require the City Redevelopment Agency to incorporate noise performance standards into the Land Use Standards, Regulations, and Restrictions outlined in Section 507 of the First Amended Redevelopment Plan.

2.0 Provision should be made for the identification and evaluation of potential noise problem areas.

- 2.1 Using the noise compatibility standards provided in Figure 2, review existing land uses to identify potential noise problems.
- 2.2 Establish an ongoing noise monitoring program to identify and evaluate noise levels in locations identified as conflict areas on the Noise Contour Map.
- 2.3 Conduct noise conflict mapping for land use categories not included in this analysis,

particularly residential land uses.

3.0 Existing and potential incompatible noise levels in problem areas should be reduced through land use planning, building and subdivision code enforcement and other administrative means.

3.1 Locate proposed developments in the City on the Noise Contour Map to determine if there is a potential impact on the development or, conversely, if the development will increase noise levels in a relatively quiet area. The development review and environmental review processes should include a further analysis in areas of potential impact.

3.2 Discourage development of noise sensitive uses in incompatible noise-impacted areas, particularly adjacent to Highway 101, the Municipal Airport, and the Southern Pacific Railroad.

3.3 Strictly enforce all existing noise control regulations, including building and subdivision laws.

3.4 In existing or future development in noise-impacted areas, especially surrounding the Municipal Airport, encourage or require through ordinance that proper site planning and insulation measures be taken to reduce noise to establish levels.

3.5 Require public housing constructed in noise conflict areas to incorporate noise attenuation measures in site design and construction techniques and materials such that HUD guidelines are met.

4.0 Existing and potential incompatible noise levels in problem areas should be reduced through operational or source controls where the City has responsibility for such controls.

4.1 Establish routes for use by heavy trucks away from noise sensitive land uses.

FIGURE 2

LAND USE COMPATIBILITY GUIDELINES

EXPLANATION
FOR
FIGURE 2

Clearly Acceptable	Normally Acceptable	Normally Unacceptable	Clearly Unacceptable

Clearly Acceptable

The noise exposure is such that the activities associated with the land use may be carried out with essentially no interference. (Residential areas: both indoor and outdoor noise environments are pleasant.)

Normally Acceptable

The noise exposure is great enough to be of some concern, but common constructions will make the indoor environment acceptable, even for sleeping quarters. (Residential areas: the outdoor environment will be reasonably pleasant for recreation and play at the quiet end and will be tolerable at the noisy end.)

Normally Unacceptable

The noise exposure is significantly more severe so that unusual and costly building constructions are necessary to ensure adequate performance of activities. (Residential areas: barriers must be erected between the site and prominent noise sources to make the outdoor environment tolerable.)

Clearly Unacceptable

The noise exposure at the site is so severe that construction costs to make the indoor environment acceptable for performance of activities would be prohibitive. (Residential areas: the outdoor environment would be intolerable for normal residential use.)

4.2 Undertake a specific study to establish a land use compatibility plan based on current and future noise projections. This plan should include an assessment of the potential for modifying aircraft operations, including hours and flight patterns and land uses around the airport operations, and to reduce excessive noise levels. In addition, the study should evaluate the effect of increased air traffic on surrounding County impacted areas as discussed in Implementation Strategy 6.3.

4.3 Seek to restrict the type of aircraft allowed to operate at the Municipal airport if certain aircraft are found to emit excessive noise.

4.4 Implement operational controls (e.g., flight path modification) for specific aircraft if those aircraft emit excessive noise.

4.5 Encourage the Southern Pacific Transportation Company to control its operations to reduce noise impacts on the City.

4.6 Consider noise abatement of stationary sources in cases of excessive noise emissions.

5.0 A program should be developed for the education of the community in the nature and extent of noise problems in the City.

5.1 Develop an information release program to familiarize residents of Santa Barbara with the Noise Element and noise problems in general. Special attention should be paid to identifying and informing those people now residing or working in noise problem areas.

5.2 Provide developers and builders with specific design information to reduce noise levels in new and existing developments. (See publication entitled "Evaluation of Outdoor to Indoor Noise Reduction of Building Facades and Outdoor Noise Barriers," by Russell B. DuPree, 1975.)

5.3 As part of the permit application process, inform developers and building contractors about potential construction noise problems and measures to reduce construction noise.

5.4 Maintain a noise information library for both the general public and those with technical backgrounds involved in noise control.

6.0 Noise control activities should be coordinated with those of other responsible jurisdictions.

6.1 Encourage the State Department of Transportation (CALTRANS) and the County Engineer to incorporate noise reduction methods, such as barrier walls, in new road construction and improvements to existing roadways.

6.2 Coordinate noise monitoring activities with those of Caltrans with regard to Highway 101 and other major State roadways, and with the County of Santa Barbara with regard to acceptable noise levels surrounding the Municipal Airport and the County Bowl, and with the County Health Department in all other identified conflict areas.

6.3 Evaluate the effects of increased air traffic on surrounding County impacted areas such as Hope Ranch and University Village.

6.4 Coordinate with the Santa Barbara Municipal Airport Noise Abatement Committee in its efforts to encourage working relationships between all interested parties in order to establish consistent and constructive methods of control over arriving and departing aircraft at the airport.

6.5 Encourage the development and use of a uniform noise evaluation scheme at all levels of government.

6.6 Coordinate the land use compatibility study referred to in implementation Strategy 4.2 with that of the County of Santa Barbara with regard to acceptable noise levels and land use planning.

7.0 Provision should be made for periodic review and revision of the Noise Element.

7.1 Review the Noise Element at least every two years and comprehensively revise it every five years or whenever major changes in the noise environment occur.

7.2 The Noise Element should be reviewed when revisions or preparation of the following plans or elements occur: Airport Land Use Plan, Land Use Element, Circulation Element, Housing Element and Conservation Element.

7.3 Integrate the task of implementing the policies of the Noise Element into the responsibilities of the Current Planning Division and the City Building Official.

TECHNICAL REPORT

FOREWORD

This Technical Report is the second of two sections which together constitute the Noise Element for the City of Santa Barbara. The first section, the Policy Report, will be submitted with this report to the City Council for adoption as one of the state-mandated Elements of the General Plan. It is intended that, once adopted, the Noise Element will be updated on a regular basis.

The purpose of this portion of the Noise Element is to provide the necessary technical back-up for the recommendations contained in the Policy Report. The technical nature of some of the information contained in this section necessitates a scientific discussion. However, because of the diverse audience of the Noise Element, the approach has been to minimize the use of detailed mathematical presentations and scientific terminology. Rather, this Report relies for the most part on qualitative descriptions of methodology and noise exposure.

Those wishing a more detailed discussion of noise evaluation techniques are referred to the works listed in the References Section.

INTRODUCTION TO NOISE

Sound Mechanics

Fundamental to any discussion of environmental noise is an understanding of sound phenomena. Such an understanding is interdisciplinary in that the generation of sound waves is within the traditional domain of physics while the perception of sound is primarily a concern of physiology and psychology. In this section, the emphasis is on the source of sound waves. The next section deals with the reception of sound, and is followed by a discussion of sounds that are defined as noise in the Element.

Sound can be defined as a mechanical form of radiant energy which is transmitted by longitudinal pressure waves in air or another medium. To illustrate this definition, consider a tuning fork in vibration after being struck. As a tong of the fork moves in one direction, it compresses the air particles in its path producing an area of *condensation*. As the tong reverses direction, the air particles left in its wake spread out resulting in an area of *refraction*. This movement of air particles is a form of wave motion in which the displacements are *along* the direction of the wave motion and is termed *longitudinal* wave motion. This is in contrast to *transverse* waves, such as those in a vibrating string, in which the displacements are perpendicular to the direction of wave motion.

Sound waves emitted by a source have two major dimensions: *frequency* (or pitch) and *amplitude* (or intensity). Frequency is measured by the number of sound waves passing a point in one second. This measure is termed "cycles per second" or "Hertz" (abbreviated Hz). In general, humans can hear sounds with frequencies from about 16 to 20,000 Hz, although those limits may be decreased or increased somewhat depending on the individual and the intensity of the sound. Sound waves below 16 Hz are in the realm of *infrasonics,* and cannot be heard. *Ultrasonics* refers to sound waves above 20,000 Hz which generally cannot be detected by the human ear either.

Amplitude is a measure of the height or depth of sound waves above and below a median line on a diagram or a sound wave (Figure 1). It is the intensity or magnitude of the sound, and is measured in decibels (abbreviated dB). The decibel system is a relative logarithmic scale of sound pressure which is based on human hearing. The scale has a number of important features. Its basic reference point is the weakest sound which a person with very good hearing can detect in a quiet place. This quantity of sound is assigned the value 0 dB. Since the range of sound pressure which the ear can detect is so great, it is necessary to mathematically compress that range on a logarithmic scale of 0 to about 180. The most important aspect of this scale is that it does not progress arithmetically or linearly. That is, while a 10 dB sound is ten times as intense as a 0 dB sound, 20 dB sound is 100 times as intense as 0 dB (rather than 20 times), and 30 dB is 1000 times as intense as 0 dB (rather than 30 times).

Another important feature of the decibel scale is that sound levels are not directly combined when they are added. For example, if one truck emits 65 dB while idling, parking another truck producing 65 dB next to it does not generate a total noise level of 130 dB. Rather, the total noise level would be 68 dB. The basis of this is the logarithmic nature of the decibel scale, and it is an important feature to remember when considering an area exposed to more than one source of noise. A convenient graphic method for combining decibels is provided in Figure 2.

FIGURE 1

FIGURE 2

Hearing

"If a tree falls in the woods and no one hears it, is there a sound?" This is an old question, and it serves to emphasize the three major facets of sound: generation, transmission and perception. The following gives a brief description of the perception of sound, or what happens when someone hears the tree fall.

The ability to hear involves a highly complex process and mechanism. The diagram in Figure 3 is a simplified picture of the ear which illustrates its three major parts: the outer, middle, and inner ear. The outer ear may be thought of as an air-filled funnel ending in a membrane, the eardrum. Sound waves travel down the funnel and impinge on the eardrum causing it to vibrate. This vibration mechanically transmits the sound wave to the middle ear which consists of a set of three connected bones. These small bones act as levers to amplify the vibrations on the ear drum, and to distinguish sound waves from the eardrum from those coming through other head tissues and bones. This part of the ear ends in a sound membrane called the oval window which separates the air-filled middle ear from the liquid-filled inner ear or cochlea. The window transmits the mechanical vibrations into liquid waves which travel through the spiral, parallel tubes of the cochlea. A basilar membrane separates two of these tubes; and, as it is distorted by the liquid waves, hair-like cells (cilia) are bent and trigger nerve cell endings by mechanical, chemical and electrical processes. These signals are transmitted to the brain through the auditory nerve.

It is interesting to note that the ear is sensitive to a wide range of acoustic stimuli, but has not evolved involuntary response mechanisms to protect it from very loud noises without temporary or permanent loss of hearing acuity. This contrasts with the eye, which has evolved the dilation mechanism to protect it from overstimulation by light. It is thought that an analogous mechanism to dilation has not developed in the ear because the environmental stimulus, i.e., frequent exposure to loud noise, has not been present. Whether existing levels of noise in large cities are sufficient to initiate natural selection processes is difficult to say, but in any event such adaptation in man would take a long time. The human ear, then, is not well adapted to high levels of noise. This highlights the need to control loud noise before it reaches the ear.

There are a number of important aspects of the hearing process that enter into the evaluation of noise exposure in this Element. One is that the ear does not perceive all frequencies of sound equally. Generally, people are more sensitive to sounds in the higher frequencies than lower frequencies. This means that it takes a greater magnitude low frequency sound to be perceived as equal in loudness to a high frequency sound. This fact is accommodated in noise measurement by the use of an electronic filter in sound level meters that enables a meter to approximate the response of the human ear. Such measures are made by using the A scale of a meter, and are noted by the letter A in the abbreviation dBA. Other measurement scales are the B and C scales which discriminate less against the lower frequencies, and therefore show somewhat higher decibel readings than the A scale (Figure 4).

Another characteristic of human perception of sound is that it takes much more than twice a reference sound energy level to perceive a doubling in loudness. The average person can detect a difference in sound level at 2 dB, but laboratory hearing tests indicate that it takes about a 10-decibel increase for most people to perceive a doubling of loudness. Field experimentation with aircraft noise indicate that the doubling of loudness can be perceived over a wide range, but the 10 dB increase per doubling of loudness is an acceptable rule of thumb.

To give a better idea of the everyday meaning of some of the above concepts, Table 1 provides a number of examples of sound sources, their approximate decibel output, their relative energy content, and the human response to those sounds.

FIGURE 3 & 4

TABLE 1
SOUND LEVELS AND HUMAN RESPONSE

Relative Sound Energy	Noise Level, dBA	Example	Response	Relative Loudness (Approximate)
1 quadrillion	150	Carrier Deck Jet Operation		32,768
100 trillion	140		Initial Pain Threshold	16,384
10 trillion	130		Initial Discomfort Threshold	8,192
1 trillion	120	Jet Takeoff (2,000 feet) Auto Horn (3 feet)	Maximum Vocal Effort	4,096
100 billion	110	Riveting Machine Jet Takeoff (2,000 feet)		2,048
10 billion	100	Garbage Truck		1,024
1 billion	90	Heavy Truck (50 feet)	Very Annoying Hearing Damage (8 hours)	512
100 million	80	Alarm Clock	Annoying	256
10 million	70	Freeway Traffic (50 feet)	Telephone Use Difficult Intrusive	128
1 million	60	Air Conditioning Unit (20 feet)		64
100,000	50	Light Auto Traffic (100 feet)		32
10,000	40	Bedroom, Library	Quiet	16
1,000	30	Soft Whisper (15 feet)	Very Quiet	8
100	20	Broadcasting Studio		4
10	10		Just Audible	2
1	0		Threshold of Hearing	1

Noise

GENERAL

At what point does sound become noise? The answer to this question is difficult primarily because of the subjective nature of noise. The American National Standards Institute (ANSI) defines noise as 1) any erratic, intermittent, or statistically random oscillation; or 2) any unwanted sound. It is the definition of noise as unwanted sound that causes difficulty in specifying what is noise and what is not. A common example of the difficulty is music. What may be rock and roll to some is noise to others. Resolution of this problem at the community level requires a large measure of public participation in defining "acceptable sound."

NOISE ELEMENT

The sources of noise may be thought of as either indoor or outdoor sources. Indoor noise includes all of those devices and machines in homes, offices, and factories that can create sounds loud enough to damage hearing, interfere with speech communication, and arouse a person from sleep. The concern of this Element, however, is outdoor noise. While both indoor and outdoor noise sources are regulated at the Federal level by the EPA and the Occupational Health and Safety Administration, control of outdoor noise is also a function of local government.

Outdoor noise can be considered in five categories: transportation, construction work, industrial operations, the individual human being (shouting, playing radio too loudly), and miscellaneous noises such as air conditioning units attached to windows or the banging of garbage cans and lids. Of these different categories, noise generated by transportation is the most serious. Transportation accounts for the most continuous and, in many areas, the loudest noise in urban centers. The emphasis of this Element is on evaluating and planning for transportation noise.

Transportation noise sources are considered in this report in three categories: air, road, and rail traffic noise. It should be noted that noise produced by aircraft in flight is regulated by the Federal government, and that much of the land within the 60 dB CNEL for the Municipal Airport is under the jurisdiction of the County of Santa Barbara. However, the CNEL contours for the Airport are included as a mandated part of this Element to assist in land use planning for the area immediately adjacent to the Airport which is within the City limits.

ROAD TRAFFIC NOISE

Within the City of Santa Barbara, road traffic is the most significant source of noise in terms of continuity and the size of the impacted area. This results simply from the fact that there are greater volumes of road traffic than air or rail traffic, and from the fact that roads exist in areas where there is no airport or rail line.

Road traffic noise is generally dominated by emissions from automobiles and heavy diesel trucks. There are five other categories of vehicular noise sources: motorcycles, sport cars, light trucks, large gasoline-engine trucks, and buses. Generally, motorcycles and sport cars are noisier than automobiles because of higher engine speeds and less adequate muffling. Light trucks emit noise levels that are similar to automobiles, while the larger gasoline-fueled trucks are noisier than cars but quieter than diesel-fueled trucks of equal size. Buses are much noisier than automobiles on city streets, but are quieter than diesel trucks on the highway because they are usually better muffled and maintained. As a group, these five types of vehicles normally comprise only a small percentage of the total daily traffic flow. Since their noise emissions are within the range defined by auto and truck emissions, their noise is generally assumed to be contained within the mix generated by cars and trucks.

The principal components of both automobile and truck noise are three: the engine, exhaust and tires. Fans operating as part of the cooling system are a major contribution to engine noise; hot gases escaping out of the exhaust pipe create noise in that area of the vehicle; and the escape of air from between tire treads and the road surface is the source of tire noise. Four major factors control the noise level of vehicles: speed, acceleration, road grade and road surface. Generally, vehicular noise levels increase directly with increases in speed, acceleration, and road grade, and with rougher road surfaces. Figures 5 and 6 show the generalized noise spectra of an auto and a truck operating on level, average road surfaces at highway speeds.

FIGURE 5

FIGURE 6

RAIL TRAFFIC NOISE

There is only one active rail line in the City of Santa Barbara -- the Southern Pacific Transportation Company's line which runs near U.S. 101. At one time, the railroad was the principal transportation mode in the County (and throughout the State), but with the age of the internal combustion engine, railroad passenger service has declined almost to extinction. Freight traffic is now the railroad's principal income producer, but even freight operations must compete with trucking and air cargo operations. Southern Pacific's line in the City is little used, except for two Amtrak passenger trains and an average of 12 freight trains per day.

Noise produced by rail traffic in the City consists of events which are widely separated in time, but which are intense. Unlike road traffic, train noise is not considered as continuous. When a train passes through, however, it produces a very intense noise, often exceeding 100 dB (at 100 feet from the track centerline).

The two major components of rail traffic noise are locomotive noise and passenger or freight car noise.

The locomotive produces the most intense noise which is generally thought to be a function of speed and track bed gradient. The relationship between speed and noise output is less well established, however, than the relationship between grade and noise output. Locomotives pulling upgrade generate significantly more noise than those operating under level or downgrade conditions.

In contrast, car noise is dependent upon velocity and increases directly with increases in speed. The wheel-track interaction is also a primary factor in noise output. Jointed track, frogs and grade crossings, and tight radius curves all act to increase the noise output of rail cars. Figure 7 shows an idealized noise history for a train-passby illustrating the locomotive and car components of train noise.

FIGURE 7

AIR TRAFFIC NOISE

The type of noise generated by air traffic is directly related to the type of propulsion system used in the aircraft. The Santa Barbara Municipal Airport is used by a variety of aircraft ranging from private single-engine piston-powered propeller aircraft to commercial turbofan jet aircraft.

The majority of aircraft using the Airport are general aviation propeller types. Noise emissions from these aircraft are produced primarily by engine exhaust and the intersection between the rotating propeller and the air. The amount of noise generated by light aircraft is primarily a function of the throttle setting. Thus, aircraft under full power on takeoff make a great deal more noise than aircraft under low power on the landing approach. The tip of the rotating propeller is constantly breaking the sound barrier, and the greater this "bite" of the propeller, the higher the noise level. The amount of bite is related to the rate of climb which is greatest on takeoff when the plane is pulling its greatest load. There are a number of combinations of propeller pitch, flap settings, air speeds and other parameters which can be adjusted to achieve a rate of climb. Therefore, the same aircraft can be much noisier in the same flight pattern depending on the pilot's selection of takeoff parameters. Thus, "low noise" modes can be achieved with light aircraft under certain operating conditions. These operational characteristics are generally controlled by gross weight of the aircraft and ambient weather conditions. As a result, propeller aircraft exhibit a wide range of noise levels.

In contrast to the buzzing noise of propeller aircraft, jets produce noise by high velocity exhaust and compressor machinery. The exhaust nozzle discharges a fast moving, hot air mass which meets the cool, relatively motionless ambient air and creates turbulence. This results in the loud blowtorch type noise heard at takeoff. The compressor blades are responsible for the high-pitched whine dominant in landings.

The turbofan jet aircraft which service the Santa Barbara Municipal Airport have fan stages which significantly reduce the exhaust velocity. These fan stages, however, are a major noise producing component in the turbofan engines. The human ear is very sensitive to the particular sounds produced by these engines. Consequently, the jet aircraft which service the Airport have less jet roar but higher intensity jet whines.

The engines of a small percentage of the Boeing 727 aircraft which use the airport have been treated with sound absorbing material to comply with Federal Aviation Regulation (FAR) 36. The remainder of Boeing 727s and 737s and DC-9s which serve the Airport do not comply with FAR 36 at this time.

Total operations at the Santa Barbara Municipal Airport amounted to 228,384 in 1977. Of these, 5,923 were air carrier movements using jet aircraft. Community Noise Equivalent Level (CNEL) contours were estimated for the Airport in 1972 by Bolt, Beranek & Newman, based on 201,115 annual operations, including 6,570 jet air-carrier movements. The Santa Barbara County Planning Department recently collected noise measurements at five locations near the Airport to determine the accuracy of these projected CNEL contours. Their results lead them to conclude that the CNEL contours projected in 1972 provide a reasonably accurate description of existing noise exposure from current levels of aircraft activity at the Airport. Therefore, these CNEL contours which were incorporated into Santa Barbara County's Noise Element are also included in the Noise Contour Maps for the City's Noise Element.

METHODOLOGY

Philosophy of Analysis

When evaluating noise exposure, it is necessary to account for a number of diverse parameters. These include not only sound wave amplitude and frequencies, but also the time characteristics of the noise, reverberation and attenuation by structures and other barriers, the hearing ability of individuals exposed, and their activity during exposure. Such a description entails the use of several numerical indicators and would be specific to a particular site and situation. However, when evaluating noise exposure on a regional and community basis, such a complete description would be impractical. It is necessary then to choose a less detailed but reliable indicator of noise exposure and potential noise problems. This is the approach taken in this Noise Element.

The rating scheme used in this Element to describe transportation noise is the Day-Night Noise Level which results in a generalized single-number indicator of noise exposure. While the establishment of a completely valid single-number noise exposure index has been the goal of psychoacoustic experts for many years, no indicator has proven to be a fully adequate substitute for more complex descriptions. With that qualification in mind, it can be said that the single-number indices are useful tools in defining noise exposure for general planning purposes.

One other qualification regarding the noise exposures described in this report should also be noted. The noise levels were defined by use of mathematical models which rely heavily on the validity of the input data. In a number of instances, these data were incomplete or not available, and it was necessary to make reasonable estimates. In developing these estimates, a conservative approach was taken at each stage of data analysis. The end result of this process is that the noise exposures computed in this analysis may be somewhat high and could be considered to contain a "margin of safety." The intent of this approach is to ensure that any error introduced into the process is on the side of public benefit.

Measurement Scheme:
Day-Night Noise Level

L_{DN}

In recent years, there has been a proliferation of noise rating schemes or techniques, and different agencies of the Federal and State governments have adopted different techniques. The result has been a general confusion by both government administrators and the public. A resolution to this problem has yet to be found in a uniformly accepted, single-number index of noise exposure that can be applied to all types of noise sources and that accurately reflects human response to sound.

To date, the most promising noise exposure index to be developed is the Day-Night Noise Level (abbreviated L_{dn}).

This index is based on two premises regarding human response to sound. The first is that humans will respond to a *steady* noise over a given period of time in the same way that they will respond to a *time-varying* noise with an equivalent

amount of sound energy as the steady noise. The second premise is that humans are generally more sensitive to noise during the night than during the day.

The dominant characteristic of transportation noise is that it is not steady. There are constant fluctuations which may or may not be widely separated in time. At any given moment near a freeway or rail line, it may be quiet, but when traffic volumes or speeds increase that quiet is quickly displaced by high noise levels. Therefore, it is not appropriate to measure noise at any given moment and call that the noise level of the source. A statistical approach is required to account for the time-varying nature of the sound. Such an approach, however, would yield a large number of statistics to show the day, night, weekday, weekend, fair and foul weather differences in noise levels. Such a large number of parameters make baseline noise level mapping and noise control enforcement extremely difficult, if not impossible, to accomplish on a community-wide basis.

The problem of time-fluctuating noise levels is further complicated by the fact that people are exposed to different sources of noise as they move from place to place in the community. For example, a typical factory worker spends time in a relatively quiet residential setting during the night, drives to work in high noise traffic, works around loud machinery all day, except for a quieter period at lunch, and then returns home. This pattern of exposure to different noise levels increases the number of descriptive parameters needed to evaluate the total noise "dosage" of people as they move through the day, and complicates the task of setting standards to protect human health and welfare.

To avoid a large number of noise indices, it became necessary for acousticians to develop single-number indicators. As the basis of such indicators, it has been shown that humans respond to steady noises in generally the same way as to fluctuating noises with equal energy content. The level of a constant sound which has the same sound energy as does a time-varying sound is termed the *Equivalent Sound Level* (abbreviated L_{eq}).

The L_{eq} concept was first introduced in Germany in 1965 to evaluate aircraft noise and has since received wide use in many countries. It has been adequately demonstrated that the L_{eq} can be used to describe the noise levels which cause annoyance and lead to permanent hearing loss.

The Day-Night Noise Level is based on the L_{eq} and the premise that noise at night is more annoying than daytime noise. This is primarily a reflection that most people sleep during the night. The L_{dn} uses the A-scale weighted L_{eq} as the basic expression of noise levels, over a 24-hour period, but applies a 10-dB penalty to the noise which occurs during the night hours (defined as 10:00 p.m. to 7:00 a.m.). This means that the method makes noise levels measured at night 10 dB higher than they actually are. The summary definition of L_{dn} is: the A-weighted average sound level in decibels during a 24-hour period with a 10-dB weight applied to nighttime sound levels.

The considerations discussed above form the basis of the rationale for selecting the L_{dn} as the primary noise evaluation scheme for the Noise Element. In summary, the L_{dn} has the following desirable characteristics:

1. The L_{dn} utilizes A-scale measurements of noise corrected for time-variance and nighttime exposure and, therefore, is a reliable single-number index of human response to noise.
2. The measure can be applied to any source of environmental noise, thereby providing a common scale to compare (and add) noise exposure from different sources.
3. The measure can be easily calculated from sound level meter recordings.
4. The measure can be used in predictive methodologies to estimate future noise levels.

CNEL

The L_{dn} represents an evolution of a noise measurement scheme called the Community Noise Equivalent Level (CNEL). The CNEL is virtually identical to the L_{dn}, but for one parameter. Rather than dividing the 24-hour day into two parts, the CNEL scheme adds a third period, the evening, which is defined as 7:00 p.m. to 10:00 p.m. Noise events during this evening period are assigned an additional 5 dB weighting.

CNEL and L_{dn} noise levels usually agree within plus or minus 1 dB for the same noise. The evening noise weighting has not been shown to yield a better indicator of human response to sound, and is considered an unnecessary complexity in the scheme. Therefore, it was dropped when the L_{dn} was developed. However, the CNEL scheme was used to compute noise exposures of aircraft in flight in the analysis conducted in 1972 by Bolt, Beranek & Newman for the County of Santa Barbara. This analysis was conducted to meet the requirements of California Administration Code, Title 4, Subchapter 6, which mandates the use of the CNEL scheme in evaluating noise around airports. Therefore, the air traffic noise levels indicated on the Noise Contours Map for this Element are expressed in CNEL. The contours were obtained from Santa Barbara County's Planning Department.

It is important to remember for the purpose of this Noise Element that there is no significant difference between the L_{dn} and CNEL noise levels. They may be compared directly and combined using "decibel addition" to estimate the total noise exposure of a site.

Direct Measurement

Noise levels at parks, schools, hospitals, and industrial sites were determined by direct measurement in accordance with amended requirements for Noise Elements. Measurements were made with a Pulsar Instruments Model 40 Sound Level Meter. Sound levels at these sites are described in terms of statistical noise levels, termed L_{10} and L_{50} sound levels. The L_{10} level is that level exceeded 10 percent of the measurement time period, and the L_{50} level is the level 50 percent of the time. For example, the notation L_{10} = 68 dBA means that for six minutes of each hour, the noise level exceeds 68 decibels as measured on the A-scale of a sound level meter. An L_{50} = 55 dBA means that for 30 minutes of each hour, the noise level exceeds 55 decibels as measured on the A-scale of a sound level meter. When the L_{10} and L_{50} levels are identical, or nearly so, it is an indication that the sound level being measured is constant, that is, a sound of an intensity which does not fluctuate widely with time.

Mathematical Modeling

GENERAL

Noise environments around roads and railroads were computed according to mathematical models of road and rail traffic noise developed by Wyle Laboratories. Specifically, the models used are published in *Development of Ground Transportation Systems Noise Contours for the San Diego Region* (Wyle Research Report WCR 73-8; for road traffic), and *Assessment of Noise Environments Around Railroad Operations* (Wyle Research Report WCR 73-5; for rail traffic). These models are based on a large sample of field noise measurements of road and rail traffic, and predict L_{dn} noise levels as a function of specified traffic data.

A modeling approach was taken in developing the noise contours for two reasons: (1) collection of input data for the models was more practical than collection of field measurements under the time and budget constraints of the study, and (2) modeling techniques for L_{dn} noise levels have been shown to be just as reliable as calculations based on field measurements. As a basis for this second reason, it should be remembered that the L_{dn} is not measured directly, but is calculated from measurements. These calculations require making estimates and developing averages that are subject to the same limits of error as mathematical modeling.

The exact expression of L_{dn} levels is found in integral calculus. For applications to road and rail traffic, however, it is possible to approximate the L_{dn} by expressions which avoid computation of the integral, and are accurate to within less than plus or minus 1 dB. The basic expression is:

$$L_{dn} = \overline{\text{SENEL}} + 10 \log N - 49.4$$

where,

$\overline{\text{SENEL}}$ = Average Single Event Noise Exposure Level

N = Number of road or rail operations

49.4 = A normalization factor equal to 10 log (3600 x 24) and where,

$$SENEL = L_{max} + 10 \log_{10} t_{ea}, \text{ dB}$$

with,

L_{max} = maximum noise level as observed on the A scale of a standard sound level meter

t_{ea} = effective time duration of the noise level in seconds. It is about equal to ½ of the "10 dB down duration" or the duration for which the noise level is within 10 dB of L_{max}

and,

$$N = N_D + 10N_N$$

with,

N_D = Number of operations between 7 a.m. and 10 p.m.

N_N = Number of operations between 10:00 p.m. and 7:00 a.m.

The value of the modeling procedure is that the SENEL has been defined through sample measurements and correlated to such factors as vehicle speed and acceleration. This kind of information then, along with the number of operations, can be used to predict the L_{dn} noise levels. Other factors, such as existing noise barriers, can also be accounted for through modeling in estimating the propagation of noise into the community.

INPUT DATA

The importance of the input data in mathematical modeling cannot be understated. The accuracy of the final noise level estimate relies heavily on this information as a description of the "real world." The following lists of information describe the kind of input data used in calculating the noise levels of transportation sources. Specific compilations of these data for the City of Santa Barbara are contained in Appendix B.

ROAD TRAFFIC DATA

1. List of roads selected for evaluation.
2. Road segment identification as defined by the following parameters (no. 3 through 9). When one of these parameters changes, a new road segment is defined.
3. Average Daily Traffic (ADT) broken down into hourly flows for the daytime (7:00 A.M. to 10:00 P.M.) and the nighttime (10:00 P.M. to 7:00 A.M.).
4. Lane configurations: number of lanes and average width of median strip divides, if any.
5. Percentage of diesel truck traffic on the road segment.
6. Representative speeds for road segments as determined by the posted speed limit and observations of variations to that limit.
7. Road grade conditions: mild (0 to 2 percent), moderate (3 to 5 percent), and severe (greater than 6 percent).

8. Lane distribution of road traffic by vehicle class; i.e., if the road has more than two lanes, what percent of total cars (and trucks) are in each lane.

9. Road sideline terrain characteristics; i.e., is the sideline elevated, depressed, or level with the roadbed.

RAIL TRAFFIC DATA

1. Line segment identification.
2. Representative train speeds.
3. Average train lengths.
4. Grade conditions. Grades are considered in three categories: Level (within ± 0.75 percent), upgrade (greater than + 0.75 percent) and downgrade (greater than - 0.75 percent).
5. Sideline characteristics.
6. Identification of track characteristics:
   a. Mainline welded or jointed track.
   b. Low speed classified jointed track.
   c. Presence of switching frogs or grade crossings.
   d. Tight radius curves
      i. radius less than 600 feet
      ii. radius 600 to 900 feet
      iii. radius greater than 900 feet
   e. Presence of bridgework
      i. light steel trestle
      ii. heavy steel trestle
      iii. concrete structure
7. Number of operations broken down into the number of day and night operations.

The information describing road traffic in the City was provided by the City's Department of Transportation, Santa Barbara County Transportation Study, and CALTRANS. Rail traffic data were provided by the Southern Pacific Transportation Company and obtained from Santa Barbara County's Draft Noise Element. The References section lists the sources of published and unpublished data used in computing noise exposures.

Future Noise Projections

GENERAL

In planning for noise control at the local government level, it is necessary to consider what the future noise environment may be like. For the most part, two factors will control environmental noise levels over the next 20 years. These are (1) the level of use transportation facilities will receive, based on estimates of demand; and (2) advances in noise reduction technology and better application of existing technology. It is safe to assume that noise emissions will be reduced at the source to a certain extent. That reduction may be counter-balanced, however, by an increase in the number of sources, specifically, the volume of traffic. In addition, there are limits to what can be achieved in technological solutions to the noise problem. For example, a major contributor to road traffic noise is tire noise. Reductions in tire noise are limited, at least in existing technology, by safety considerations in tread design.

Because of the limitations of technology and the expected increase in traffic, land use regulation will be a necessary part of noise control over the next 20 years. Through a combination of noise source control by the Environmental Protection Agency and land use control by local governments, a noise environment compatible with a variety of activities can be achieved.

ROAD TRAFFIC

In forecasting 1990 noise levels from road traffic, it has been assumed that automobiles and trucks will still utilize rubber tires on asphalt and concrete surfaces. This assumption limits the amount of noise reduction which can be expected from technological means alone. Even if engine and exhaust noise could be eliminated, the interaction between tire tread and road surface would continue to emit high noise levels.

The characteristics of automobile noise are expected to remain the same as existing vehicles, but the level of noise is forecast to decrease by about 3 dB over the typical range of operating speeds (Figure 8). This level of noise reduction assumes enforcement of legal constraints and application of currently available technology.

Noise emissions from heavy trucks are also assumed to decrease for the forecast year. This will require application of current "state-of-the-art" technology at the production level. Such technology indicates that maximum noise levels of 70 dBA at 50 feet are attainable. This represents a noise level reduction of 10 to 15 dB from some models currently in use (Figure 9). Levels much below 70 dB do not seem to be feasible at this time because of economic and safety considerations in tire design.

Overall noise levels from road traffic, then, are assumed to decrease at the source for purposes of this Element. If legal constraints go unenforced, or if adequate noise control technology is not applied, noise levels will, of course, increase. Conclusions from the Santa Barbara County Transportation Study indicate road traffic volumes may double in some areas of the City by 1990. This translates into a 3 dB increase in noise levels. Since it is always possible that the necessary noise control technology will not be applied in the coming years, it is necessary to review this Element periodically to assess the validity of the noise projections.

FIGURE 8

FIGURE 9

RAIL TRAFFIC

For the general planning purposes of the Noise Element, the noise levels associated with current rail traffic are assumed to describe noise levels for the forecast year. The rationale for this assumption is twofold. Either the railroad will continue to carry freight and few passengers at current volumes, or the railroad will be restored as a major transportation mode. If the second alternative is realized, it is most likely that major track rights-of-way alignments will be affected, and new, high-speed trains will be produced. Some data describing the expected noise effects of this alternative are available from studies of the BART (Bay Area Rapid Transit) system in the San Francisco area and from Department of Transportation studies on experimental trains. Generally, these studies forecast quieter trains which are capable of higher speeds than existing trains. It is not possible to adequately predict the effects of any of this new technology on the City of Santa Barbara. Enough information is not available at this time.

Continuation of existing levels of rail traffic noise is, therefore, the most realistic projection for at least the intermediate future. As the price of gasoline continues to increase, the relatively energy-efficient train may assume a greater share of the freight traffic in California. Measuring this possible effect and its effect on noise is difficult, and beyond the scope of this Element.

AIR TRAFFIC

Existing federal legislation will reduce future noise emissions from individual aircraft. Federal Aviation Regulation (FAR), Part 36, regulates the amount of noise that legally can be produced by newly developed aircraft. As a result of this regulation, recent aircraft types such as the Lockheed L-1011, Douglas DC-10 and Boeing 747 are quieter and less annoying than their predecessors. The exhaust nozzles and fan stages are still the primary noise producing components of the newer high bypass ratio turbofan engines, but the intensity of the noise generated by these components has been significantly reduced. However, none of these large, new aircraft types currently service Santa Barbara Municipal Airport.

FAR Part 36 also sets standards for sound modification of older, noisier turbojet or low-bypass turbofan aircraft. Fifty percent of an airline's fleet of two or three engine aircraft must be retrofit with Sound Absorbing Material (SAM) nacelle treatment by January 1, 1981. The remaining fifty percent of the fleet must be retrofit by January 1, 1983 (Mr. Altman, Hughes Airwest). Assuming that these standards are met, the noise generated by individual turbofan jets servicing Santa Barbara's Airport will be reduced by 1983. However, this improvement will be partially offset by potential increases in the number of flights.

The County's Draft Noise Element states that previous projections of future commercial air travel and general aviation activity were based on population projections for the County which are no longer considered appropriate. Therefore, in the absence of accepted forecasts of air traffic for the Santa Barbara Municipal Airport, the County prepared Table 2 to illustrate a range of future airport noise exposure possibilities. Changes in Community Noise Equivalent Level exposure near the Airport can be determined by comparing the percent increase in aircraft operations with the decibel reductions in "average" aircraft noise levels. The example presented in the County's Draft Noise Element (p. 36) which accompanied the table was the following:

"...if at some point in the future aircraft are on average 4 dB quieter than those operating today, and if at the same time total aircraft operations have increased 30%, noise exposure in CNEL will have been reduced by about 2.9 dB."

TABLE 2

Change in Airport Noise Exposure
Expressed in CNEL*

	Reduction in Average Aircraft Noise Level (dB)					
	0	2	4	6	8	10
1	0	- 2.0	-4.0	-6.0	-8.0	-10.0
10	+0.4	- 1.6	-3.6	-5.6	-7.6	-9.6
20	+8.0	- 1.2	-3.2	-5.2	-7.2	-9.2
30	+1.1	- 0.9	-2.9	-4.9	-6.9	-8.9
50	+1.8	- 0.2	-2.2	-4.2	-6.2	-8.2
100	+3.0	+1.0	-1.0	-3.0	-5.0	-7.0
150	+4.0	+2.0	0	-2.0	-4.0	-6.0

* Table Assumes:

1. Operations of all aircraft types increase proportionately.
2. No change in distribution of operations between daytime and nighttime.
3. No change in aircraft operational procedure.

Source: Santa Barbara County Draft Noise Element.

NOISE CONTOURING

Quantitative estimates of existing and future noise exposure in the City are provided in two forms in this report. Appendix C contains this data in tabular form, and the Noise Contours Maps show the data in graphic form. The noise contours are lines connecting points of equal sound intensity. They form bands 5 dBA in width along the roads, railroad, and around the Airport. Some attempt was made in this analysis to account for the attenuative effects of the more significant sideline features along the freeway and rail line. These are primarily the areas in which the route is depressed relative to the surrounding topography or is immediately adjacent to a large elevation. The effect of these sideline features is to attenuate the propagation of higher sound levels into the community. This is represented by the contour lines being closer together. Analysis of attenuation and reverberation due to small sideline features, such as buildings, is beyond the scope of this analysis and would not be appropriate to noise evaluation at a city-wide level for general planning purposes. It should be remembered, then, that the noise contours are general indicators of noise exposure and not precise levels. It should also be noted that the noise contours only represent noise generated by road, air and rail traffic. These contours will not account for interior noise or outdoor noise generated by construction work, individual persons, miscellaneous noises such as window air conditioning units, or other stationary sources.

The preparation of the noise contour maps involved a certain amount of estimating and smoothing. For example, the contour lines at intersections of roads were rounded away from the intersections indicating an increase in noise levels. Intersections are generally noisier than line sources because traffic volumes increase there. Additionally, many vehicles (e.g., trucks) create more noise under stop-and-go conditions than at steady speeds. The rounding of the contour lines represents this condition, but is not an exact estimate of the magnitude. Precise estimates should be made through site analysis.

The procedure used in contour mapping for this Noise Element is in compliance with Government Code Section 65302(g) as amended. Contours are shown in increments of 5 dB and continue down to 60 dB. Noise exposure levels for parks, schools, hospitals and rest homes were determined by direct measurement (see Appendices D, E, and F).

Noise Environment

NOISE-SENSITIVE LAND USES

The Noise Contours Maps show the location of existing and proposed parks, schools, nursing homes and hospitals as examples of noise sensitive land uses. Appendix F contains a list of the Health Care Facilities included on the maps and Guest/Rest Homes which may be considered as noise sensitive uses, but were not mapped. The omission of other land uses from the maps is not intended to imply that these are the only noise sensitive uses. Rather, these are the examples required by the Government Code.

All land uses may be considered to be sensitive to noise, but to different levels. Land use sensitivities may be thought of as a continuum with some uses able to tolerate a high level and others unable to tolerate any but the quietest level. The level of tolerable or "acceptable" noise is a function of the subjective desires of the community and the average exposure times of people in different areas. This latter concept is related to the premise underlying the Sound Equivalent Level. That is, it is acceptable to be exposed to high noise levels for part of the day as long as this exposure is compensated by being in a quiet environment later on. For example, the acceptable noise level for industrial land use is 75 dBA (L_{dn}). A person working in that environment, however, should be compensated by spending a certain amount of time in an interior residential area where the acceptable noise level is 45 dBA (L_{dn}).

The land use noise standards recommended in the Policy Report serve, in effect, to define the sensitivity of each land use. The maximum acceptable noise level for a land use is the level dividing the "Normally Acceptable" and "Normally Unacceptable" noise levels. A summary of these noise level standards is presented in Table 3. These standards may be used in identifying potential noise conflict areas as described in the next section.

NOISE CONFLICT AREAS

Potential noise conflict areas are those sections of an existing or proposed land use exposed to noise levels which are incompatible with that use of the land. They are termed "potential" noise conflict areas because both the land use and noise exposure representations are generalized. A site analysis might show that the particular area in conflict is not as sensitive as the general land use. For example, the conflict area of McKinley School occurs within 50 feet of the roadway. It could be that this area is used for parking rather than classrooms. It would also be that structures or other noise barriers exist at the site which reduce the noise to acceptable levels. The intent of identifying noise conflict areas, then, is to point out those places which deserve site analysis in a noise control program.

The actual identification of a noise conflict area is a simple, graphical problem given the noise sensitivities of various land uses and a noise contours map. By overlaying a land use map with a noise contours map, identification of conflicts can be made directly. Once these conflict areas have been identified, it is recommended that a site analysis be conducted to determine the precise nature of the noise problem, if any is confirmed to exist.

Table 4 contains a list of potential noise conflict areas in the City of Santa Barbara based on the noise sensitive land uses listed in the "Guidelines for the Preparation and Content of Noise Elements of the General Plan." It should be noted that this relatively short list of potential noise conflict areas does not consider land uses other than parks, schools and hospitals. Incompatible outdoor noise levels may well impact residential or commercial uses which were not included in this analysis. Appendix F contains a list of rest homes and noise levels at each location.

NOISE EXPOSURES

Noise exposure is defined as the total acoustical stimulation reaching a person's ear over a specified period of time. How much noise exposure is acceptable for what land uses and times of day are questions that are addressed in the Policy Report. The recommended land use noise compatibility guidelines in the Policy Report are intended to provide some answers. Using these guidelines (summarized in Table 3) as criteria for analysis, Table 5 lists the major noise sources in the various areas of the City. The guiding criteria in judging whether a transportation noise source is a "major" source is whether it emits an L_{dn} of 65 dBA or more. Noise exposures from these sources are likely to be incompatible with the more sensitive land uses such as parks, schools, hospitals and residences. These sources, then, may be considered as the potential noise problems in the City. In most cases, these sources are generating significant noise during the current year but are projected to generate lower levels in the forecast year, 1990. In other cases, however, the source may continue to be a major problem in 1990.

TABLE 3
Summary Land Use
Compatibility Standards

Land Use Category	Normally Acceptable Exterior Noise Exposure, L_{dn} dBA[1]
Residential-Single Family, Duplex, Mobile Homes, Multiple Family, Dormitories, etc.	60
Transient Lodging	70
School Classrooms, Libraries, Churches	65
Hospitals, Nursing Homes	65
Auditoriums, Concert Halls, Music Shells	60
Sports Arenas, Outdoor Spectator Sports	65
Playgrounds, Neighborhood Parks	65
Golf Courses, Riding Stables, Water Recreation, Cemeteries	70
Office Buildings, Personal, Business, and Professional	75
Commercial-Retail, Movie Theaters, Restaurants	75
Commercial-Wholesale, Some Retail Industry, Manufacturing, Utilities	80
Manufacturing-Communications (Noise sensitive)	70
Livestock Farming, Animal Breeding	75
Agriculture (except Livestock), Mining, Fishing	95
Public Right-of-Way	85
Extensive Natural Recreation Areas	75

[1] These noise exposure levels represent the upper limit of the range of "normally acceptable" noise levels. "Normally acceptable" is defined as being an exposure that is great enough to be of some concern, but common building constructions will make the indoor environment acceptable, even for sleeping quarters. Above these levels, unusual and costly building constructions are necessary to ensure adequate performance of activities.

TABLE 4
Potential Noise Conflict Areas

Heavily Impacted Areas[1]	Local Noise Source(s)
Oak Park Convalescent Hospital	Highway 101
Santa Barbara Convalescent Hospital	Highway 101
Wilson School	Highway 101
Bohnett Park	Highway 101 & Railroad
A Child's Estate	Highway 101 & Railroad
Andree Clark Bird Refuge	Highway 101 & Railroad
Dwight Murphy Field	Highway 101 & Railroad
Moreton Fig Tree	Highway 101 & Railroad
Municipal Tennis Courts	Highway 101
Palm Park	Cabrillo Blvd. & Railroad

Slightly Impacted Areas[1]	Local Noise Source(s)
Oak Park	Highway 101 & Railroad
Las Positas Park	Las Positas Road
Adams School	Las Positas Road
McKinley School	Cliff Drive
Monroe School	Cliff Drive
Santa Barbara City College	Cliff Drive
Santa Barbara Jr. High	Milpas Street
West Beach	Cabrillo & Railroad
East Beach	Cabrillo
Ambassador Park	Cabrillo
Vera Cruz Park	Haley Street
Municipal Golf Course	Highway 101

Additional Potential Conflict Areas[2]	Local Noise Source(s)
Lincoln School	Anacapa
Santa Barbara High School	Anapamu
Plaza del Mar	Castillo & Cabrillo

[1] Based on estimated contours for 1978.

[2] Based on noise monitoring.

TABLE 5
Major Noise Sources

Existing (1977/1978)	Future (1990)
70 dB(A) and above	
Highway 101	Highway 101
State Street	
Las Positas Road	
Cabrillo Boulevard	
65-70 dB(A)	
Carrillo Street	Carrillo Street
Meigs Road	Meigs Road
Cliff Drive	Cliff Drive
Milpas Street	Milpas Street
Mission Street	State Street
Anacapa Street	Las Positas Road
Santa Barbara Street	Cabrillo Boulevard
De la Vina Street	
Chapala Street	
Haley Street	
San Andres Street	
Foothill Road	
La Cumbre Road	

Conclusions and Assumptions

The following conclusions and assumptions are a summary of the major technical findings of this analysis of environmental noise in the City of Santa Barbara, and are integral to the objectives of the Policy Report.

CONCLUSIONS

1. In general, the City of Santa Barbara may be considered a relatively quiet environment. Ten potential major noise conflict areas were identified from a list of 98 possible problem areas within the City. An additional 12 potential minor conflict areas were also identified, based on the estimated locations of noise contours. Monitoring conducted at locations of noise sensitive uses revealed three more potential minor conflict areas. Of the more than one hundred road segments evaluated for traffic noise, segments on four principal roadways were associated with L_{dn} noise levels of 70 dBA of higher. This is not to say that the City is without noise problems. Rather, the major noise sources are few in number and of limited impact.

2. The most significant source of noise in the City is road traffic, followed by rail and air traffic. Of the roads evaluated for noise exposure, the following were found to be associated with L_{dn} noise levels of 70 dBA or higher: U.S. 101, State Street, Cabrillo Boulevard, and Las Positas Road. Table 5 lists roads with L_{dn} noise levels of 65 dBA or higher.

3. Rail traffic on the Southern Pacific line is infrequent, but creates intense noise events such that the total sound energy associated with the railroad is nearly equivalent to that of U.S. 101. Noise sensitive areas potentially impacted by railroad noise include Wilson School, Bohnett Park, Palm Park, A Child's Estate, Andree Clark Bird Refuge, Dwight Murphy Field and the Moreton Bay Fig

Tree.

4. The Municipal Airport is a source of local noise. California Airport Noise Standards require that, by January 1, 1986, no residential dwellings (except acoustically treated units) exist within the Airport's 65 dB CNEL contour. The Draft Noise Element for the County of Santa Barbara estimated that approximately 280 housing units are located within the 65 dB CNEL contour established by Bolt, Beranek & Newman in 1972. If the schedule for reduced aircraft noise set forth in Federal Aviation Regulation, Part 36, is met, and if the number of flights does not significantly increase, the area within the 65 dB CNEL contour could be reduced by 1983. Additional measurements should be made at that time to delineate the new contour line and the number of dwelling units remaining within the 65 dB contour, and if further noise reductions are not anticipated by 1986, these remaining units will have to be acoustically treated. The Federal Aviation Administration should be encouraged to modify aircraft operational procedures in order to reduce noise over sensitive areas. Any further residential use in areas under the City's jurisdiction immediately adjacent to the airport should be prohibited. The County should ensure that additional noise sensitive land uses are avoided within the existing 65 dB contour and preferably within the 60 dB contour as well.

5. Potential major noise conflict areas have been identified at the following sites: Wilson School, Oak Park Convalescent Hospital, Santa Barbara Convalescent Hospital, Palm Park, Bohnett Park, A Child's Estate, Andree Clark Bird Refuge, Dwight Murphy Field, Municipal Tennis Courts, and the Moreton Bay Fig Tree. An additional 12 potential minor conflict areas were also identified, based on the estimated locations of noise contours. Three more potential minor conflict areas were revealed during monitoring of noise sensitive locations (see Table 4). Appendix F contains a list of Rest Homes and approximate noise levels at each location. Further site acoustic studies should be conducted to aid in defining the precise nature of the noise problems, should any be confirmed to exist.

ASSUMPTIONS

1. Future noise levels due to road traffic are expected to be a function of increased traffic volumes and the applications of noise control technology. The analysis of this report assumes that noise control technology will be applied (as required in the California Vehicle Code, Section 27160), and that this will counteract the expected increase in road traffic in most, but not all cases. Thus, road traffic noise is forecast to remain the same or decrease somewhat by 1990.

2. Current noise levels generated by the Southern Pacific Railroad are assumed to persist for at least the intermediate future, based on the assumption that existing levels of railroad traffic remain constant. If rail traffic increases, noise levels will correspondingly increase.

3. The improvement in aircraft noise exposure resulting from compliance with Federal Aviation Regulation, Part 36, may be partially offset by increased airport activity. No dramatic reductions in aircraft engine noise are anticipated in the next 10 years unless there is a major technological breakthrough. In the absence of accepted projections of air traffic growth for the Santa Barbara Municipal Airport, the noise contours projected by Bolt, Beranek & Newman are considered as adequately describing the 1990 noise exposure.

REFERENCES

Bolt, Beranek and Newman, Inc. *Highway Noise - A Design Guide for Highway Engineers*. NCHRP Report No. 117, prepared for Highway Research Board, National Academy of Sciences, Washington, D.C. 1971.

DuPree, Russell B. *Evaluation of Outdoor to Indoor Noise Reduction of Building Facades and Outdoor Noise Barriers*. Office of Noise Control, State of California Department of Health. July, 1975.

Envicom Corporation. Noise Element, City of San Luis Obispo. 1975.

Envicom Corporation. *Noise Element, San Luis Obispo County*. 1976.

Los Angeles Department of City Planning. *EIR Manual for Private Projects*. August, 1975. (Noise Procedures updated July, 1976).

Office of Noise Control. *Guidelines for the Preparation and Content of Noise Elements of the General Plan*. Prepared in coordination with the Office of Planning and Research. February, 1976.

Olson Laboratories Inc. *Los Angeles International Airport Draft Environmental Impact Report, Aviation Forecasts and Noise*. Volume 2. 1975.

Santa Barbara County Planning Department. *Draft Noise Element*. 1978.

Swing, J.W. *Development of Ground Transportation Systems Noise Contours for the San Diego Region*. Wyle Laboratories. 1973.

Swing, J.W. *Estimation of Community Noise Exposure in Terms of Day-Night Average Level Noise Contours*. Office of Noise Control, State of California Department of Health. Draft Revised May, 1975.

Swing, J.W. and Pies, D.B. *Assessment of Noise Environment Around Railroad Operations*. Wyle Laboratories. 1973.

Wyle Laboratories. *Wyle Research Report*. WCR 74-3, Supporting Documentation for the Development of Transportation Noise Contours for the City of Los Angeles. June, 1974.

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